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TITLE: SLAT FOR LASER CUTTING MACHINE TABLE

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VERIFICATION OF A TRANSLATION

I, (name and address of translator) Marie-Claude NIEPS of 158, rue de
l'Université, 75007 PARIS - FRANCE hereby declare that:

My name and post office address are as stated above:

That I am knowledgeable in the English Language and the French Language and that I believe the English translation of the specification, claims, and abstract relating to International Application PCT/ FR03/003930 filed December 29, 2003 is a true and complete translation.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.


(signature of translator)

Date September 1st, 2004

Slat for laser-cutting machine table**Background of the invention**

5 The present invention relates to the general field of machines for cutting paper, board, thin wood, woven industrial fabric with or without a coating, leather or other materials using a laser beam; it relates more particularly to a slat system for a depositing table of a laser-cutting machine.

10 Laser-cutting machines are generally used for the precision cutting of complex shapes into products in sheet or plate form. These machines generally consist of a table on which the product to be cut is deposited and of a device for generating a laser beam.

15 Although the laser device is an essential element in these machines, the table on which the product is deposited is also a key element for obtaining quality cutting of the product of interest. Specifically, this table must support the product to be cut and have sufficient resistance to impingement by the laser beam while at the same time providing effective heat dissipation.

20 Currently, some tables for receiving the product to be cut are formed by a juxtaposition of slats whose upper surface is intended to support the product during cutting; the entirety of the juxtaposed slats forms the plane on which the product to be cut is deposited.

25 This upper surface may have a honeycomb-type structure. However, this honeycomb profile may prove difficult to clean. Furthermore, in the event of damage, the slat must be replaced in its entirety. Also, this honeycomb structure does not form a true obstacle to the progression of the laser beam, and this may cause problems in terms of damage to the underlying equipment, thus requiring the presence of an add-on element to deviate the said laser beam.

30 Also known from the abstract of Patent JP 08 108291 is a cutting table formed by a juxtaposition of plates which are inclined with respect to the direction of the laser beam in order to allow deflection of the beam between two adjacent plates.

35 The aim of this inclined arrangement of the plates is to attenuate the energy of the laser beam as it passes through the table.

However, the impact of the laser beam on the inclined plates may pollute and damage the product to be cut.

Object and summary of the invention

5 The present invention aims to overcome these drawbacks by proposing a slat consisting of a trough containing a plurality of juxtaposed inserts arranged parallel or substantially parallel to one another. According to the invention, each insert takes the form of a folded thin sheet-metal plate comprising at least two parts connected along a fold line, a first part
10 arranged substantially parallel to the direction of incidence of the laser beam and constituting a support strip whose free upper edge forms a support element for the product to be cut, and a second part which is inclined with respect to the direction of incidence of the laser beam and constitutes an oblique strip for deflecting the laser beam.

15 Consequently, the support strip of the inserts makes it possible to distance the supported product from the impact of the laser beam on the oblique strip, thus limiting the effects of possible pollution of or damage to the product.

20 The support strip of the inserts also provides the slats with better mechanical strength for supporting the product to be cut and facilitates removal of the cut product by allowing a comb to be used for unloading.

25 The slat according to the present invention thus has a simple structure and is easy to manufacture; moreover, it is easy to clean, especially by means of a rotating brush.

 According to one embodiment of the invention, each insert additionally comprises a third part, which is substantially parallel to the first part and forms a heel connected to the oblique strip along another fold line.

30 In this embodiment, the distance separating the plane of the support strip and the plane of the heel is advantageously greater than or equal to the distance between two juxtaposed inserts of the same trough. Consequently, the laser beam passing between two inserts is necessarily deviated by an oblique strip.

35 According to another particular feature, the inserts are fastened to the support trough via means which allow them to be disassembled. It

is then possible to replace the inserts independently of one another and thus to replace only those inserts which have been damaged, in particular by the laser beam, mechanical impacts or other agents.

5 The slat then advantageously comprises a trough having in particular two lateral walls whose upper ends are folded inwards forming oblique folds provided over their whole length with a plurality of openings or slots. Two mutually opposite openings accommodate the lugs of complementary shape formed on the side edges of the inserts. The assembly of the lugs in the corresponding openings then takes place
10 elastically and by clipping.

The slat may consist of inserts having a material void over a maximum area compatible with maintaining the rigidity of the said inserts. This void makes it possible in particular to significantly reduce the weight of each insert, and consequently the weight of the slat in its entirety, but
15 also to improve heat dissipation by allowing air or another agent to circulate within the said slats.

The subject of the present invention is also an insert intended for a slat as defined above.

20 The subject of the present invention is additionally a laser-cutting machine table consisting of a plurality of juxtaposed slats as defined above.

Brief description of the drawings

25 The invention is also illustrated by a specific embodiment, given solely by way of example, described below and represented in the appended drawings which follow:

- Figure 1 is a highly schematic perspective representation of a laser-cutting machine provided with slats according to the present invention;

30 - Figure 2 is a partial perspective view of a slat according to the invention for a laser-cutting table such as that represented in Figure 1;

- Figure 3 is a view from above of the trough-shaped element of the slat as represented in Figure 2;

- Figure 4 is a view in section on 4-4 of Figure 3;

35 - Figure 5 is a front view of an insert according to the invention, isolated from the trough-shaped element;

- Figure 6 is a side view of the insert represented in Figure 5;
- Figure 7 is a partial front view of an insert prior to clipping onto the receiving trough;
- Figure 8 is a partial front view of an insert clipped onto the receiving trough;
- Figure 9 is a schematic representation of a longitudinal section of the trough containing a plurality of clipped-on inserts; and
- Figure 10 is a schematic representation of a longitudinal section of the trough containing a plurality of clipped-on inserts according to a variant embodiment of the invention.

Detailed description of an embodiment

Figure 1 represents a laser-cutting machine consisting mainly of a moving table 1, of the endless conveyor type, and of a gantry 2 provided with a system for generating a laser beam 3 intended to allow cutting of a material 4 arranged on the depositing plane formed by the table 1.

The gantry 2 is arranged vertically with respect to the table 1. This gantry 2 is provided with a conventional laser system for producing the laser beam 3. The direction of incidence of the beam 3 is preferably perpendicular to the depositing plane formed by the table 1. The gantry 2 can move in three directions in order to allow displacement of the beam 3 and thus produce the various shapes to be cut.

The table 1, as represented in Figure 1, is of the endless conveyor type with an oblong longitudinal section.

This table 1 is supported by two rollers 5 with a horizontal axis 6; the two axes 6 are parallel to one another; one of the rollers 5 is motorized in order to drive the endless conveyor 1, for example in the direction of the directional arrow 7. The rollers 5 are supported at their ends by a chassis structure.

According to a variant embodiment of the invention, the table may also be of the stationary type.

This table 1 consists of a plurality of slats 8 juxtaposed transversely with respect to the direction of movement 7, parallel to the axis 6 of the rollers 5.

As represented in Figures 1 and 2, each slat 8 consists of a trough 9 (Figures 2 to 4) containing a plurality of juxtaposed inserts 10

which are parallel to one another (Figures 5 and 6). The elements 9, 10 may be made of steel or of aluminium.

5 The trough 9 (Figures 2 to 4), structural element of the slat 8, consists of a planar bottom element 11 bordered by two end walls 12 and by two side walls 13. The end walls 12 have a generally rectangular shape, the upper part 14 of which is folded over at a right angle.

This fold 14 is provided with two orifices 15 for fastening each of the ends of the said slats 8 to the device for driving the endless conveyor, for example of the flexible drive belt type.

10 The lateral walls 13, likewise of generally rectangular shape, have an upper part 16 folded over towards the inside of the trough 9 so as to form an oblique fold extending over the whole length of the said lateral wall 13.

15 Each oblique fold 16 is provided over its whole length with a plurality of uniformly distributed openings or slots 17, 17' having a generally rectangular shape extending transversely with respect to the said oblique fold 16.

The bottom element 11 has openings 18 which are separated by cross-pieces 19 contributing to the rigidity of the assembly.

20 According to one embodiment of the invention represented by Figures 5 and 6, each insert 10 takes the form of a polyhedral thin sheet-metal plate comprising three planar parts 20, 21, 22, which parts are connected by two fold lines 23 and 24 in such a way as to form a baffle.

25 The three planar parts 20, 21, 22 of the insert 10 are more precisely: a first part constituting an upper support strip 20; a second part constituting an intermediate oblique strip 21; and a third part constituting a lower heel 22. The plane of the support strip 20 and the plane of the heel 22 are substantially parallel to one another and spaced apart by a distance e by way of the oblique strip 21.

30 This shape of the insert 10 allows deviation of the laser beam 3 onto the oblique strip 21, which particularly prevents the beam from being reflected towards the cut material 4.

35 The support strip 20, of generally rectangular shape, is arranged substantially parallel to the direction of incidence of the laser beam. It is delimited by an upper end edge 25, a lower end edge 26 and two side edges 27.

The upper end edge 25 of the support strip 20 forms part of the plane on which the product is deposited; the upper edges 25 of the entirety of the inserts 10 of the slats 8 in the same plane form the surface on which the product is deposited.

5 The lower end edge 26 of the support strip 20 is connected to the oblique strip 21 by the fold line 23.

 The distance between the two side edges 27 is equal to or substantially equal to the distance between the two outer surfaces of the lateral walls 13 of the trough 9. This characteristic makes it possible in particular to provide optimum support for the product to be cut.

10 Furthermore, the support strip 20 of the inserts 10 of the slats 8 makes it possible to distance the cut material 4 from the impact of the laser beam on the oblique strip 21, thus limiting the effects of possible pollution of or damage to the material.

15 The support strip 20, which is perpendicular to the depositing plane for the material 4 to be cut, also provides the slats 8 with better mechanical strength for supporting the material. The support strip 20 allows a comb to be employed for unloading.

 The oblique strip 21, of generally trapezoidal shape, is delimited by two end edges 26, 28 and by two side edges 29.

 This oblique strip 21 is connected at its upper end edge 26 to the support strip 20 by the fold line 23 at an angle of, for example, 135°; also, it is connected at its lower end edge 28 to the heel 22 by the fold line 24 likewise at an angle of, for example, 135°.

25 The side edges 29 of the oblique strip 21 have a profile allowing partial mating with the upper surface of the oblique folds 16 of the lateral walls 13 of the trough 9.

 As described above, this oblique strip 21 is intended to provide deflection of the laser beam 3.

30 The heel 22 is delimited by two end edges 28 and 30 and by two side edges 31. The upper end edge 28 corresponds to the fold line 24.

 The heel 22 has two parts, namely an upper part of generally trapezoidal shape and a rectangular lower part. The distance between the side edges of this rectangular lower part is slightly smaller than the distance between the ends 32 of the oblique folds 16 of the trough 9.

The side edges 31 of the upper part of the heel 22 are intended to mate with the upper surface of the oblique fold 16 of the trough 9; they each have a lug 33 whose function will be explained below.

5 An oblong void 34 is made at the centre of the heel 22. This void 34 occupies an optimum area in order in particular to reduce the weight of the said inserts 8 without reducing their structural strength.

Each insert 10 is secured within the trough 9 by inserting tenons 33 into the openings 17 made in the oblique lateral folds 16, which act as mortises (Figures 7 and 8).

10 This way of securing the inserts 10 on the trough 9 allows elastic fastening, of the clip-on type. It is thus possible for any damaged insert to be replaced easily and, especially, without requiring intervention on the adjacent inserts and without disassembling the slat from the conveyor.

15 Furthermore, this characteristic makes it possible where appropriate to assign the inserts 10 to all or to only some of the openings 17 of the oblique fold 16.

20 As represented in Figures 7 and 8, the inserts 10 are positioned in the trough 9 by force-fitting their tenons 33 into two mutually opposite openings 17 of the oblique folds 16 by applying vertical pressure.

As represented in Figure 9, the inserts 10 contained in a trough 9 are then arranged parallel or virtually parallel to one another, but also parallel to the end wall 12 of the trough 9.

25 All the slats 8 juxtaposed in the same plane, and in particular all the inserts 10 contained in the said slats, form the depositing plane for the product to be cut. More precisely still, it is the upper edges 25 of the inserts 10 which form the depositing plane for the product.

30 The upper edges 25 of two juxtaposed inserts 10 are spaced apart by a uniform given distance d within the same slat; this distance d may, for example, be around 7 to 9 mm.

35 In the illustrated embodiment, this distance d separating two inserts 10 is equal to the distance e separating the plane of the support strip 20 and the plane of the heel 22. This characteristic provides deviation of the laser beam 3, preventing the beam 3 from passing through the slats 8 without deviation.

According to an alternative, this distance d may also be smaller than the distance e .

According to another embodiment of the invention illustrated by Figure 10, the inserts 10 of the slats 8 are not provided with a lower heel.

5 Each insert 10 then takes the form of a folded thin sheet-metal plate comprising only the support strip 20, the free upper edge 25 of which forms a support element for the material 4 to be cut, and the oblique strip 21 for deflecting the laser beam 3. The two planar parts 20, 21 forming the support strip and the oblique strip are connected by the
10 fold line 23.

As in the preceding embodiment, the side edges (not shown) of the oblique strip 21 of the inserts 10 have a profile allowing mating with the upper surface of the oblique folds 16 of the lateral walls 13 of the
15 trough 9.

The side edges of the oblique strip 21 each likewise have a lug
15 (not shown) for securing each insert 10 within the trough 9. This securing is achieved by inserting these lugs into openings or slots 17' made in the oblique lateral folds 16 of the lateral walls 13 of the trough 9. These openings 17' have an inclination which is substantially identical to that of
20 the oblique strips 21 of the inserts 10.

It will be noted that, in this embodiment, a void making it possible to reduce the weight of the inserts and to provide better heat dissipation may be made in the oblique strip 21 of the inserts 10. Such a void is not represented in Figure 10.

25 It will also be noted that various categories of troughs 9 whose openings 17, 17' are spaced apart to a greater or a lesser extent and inserts 10 in which the inclination of the oblique strip 21 is pronounced to a greater or lesser extent may be produced, which makes it possible to vary the distance between the upper edges 25 of the inserts 10.

30 Purely by way of example, the length of the upper strand 37 of the conveyor 1 between the two support rollers 5 may be around 4 m. The slats 8 may have a length of around 250 cm and a width of about 8 to 10 cm; the useful length of the said slat 8 may be around 240 cm.

35 To employ the machine illustrated in Figure 1, the laser beam 3 is controlled as a function of the forward travel of the conveyor 1 in order to carry out cutting, according to a programmed pattern, of the product 4.

During this cutting operation, some waste 35 may potentially drop between the inserts 10, through the lower openings 18 of the troughs 9. This waste 35 is then collected in a recovery container 36 arranged directly under the depositing plane for the product, between the two strands 37, 38 of the conveyor 1.

Waste 35 which might possibly remain wedged within the slats 8, for example between the inserts 10, is extracted continuously as the table 1 moves around by a rotating brush 39 arranged at one of the ends of the endless conveyor. This cleaning operation is optimized owing to the longitudinal arrangement of the inserts 10.

When the table 1 is of the endless moving conveyor type, the cut material 4 is generally removed at one of the ends of the table. This operation is performed by a tool (not shown) provided with combs designed to be inserted between two adjacent inserts 10 of the slats 8 as the table moves around. The presence of a support strip 20 perpendicular to the depositing plane for the material 4 facilitates the positioning of these combs, and therefore the removal of the cut material.